PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. II. 1846-7. No. 29.

SIXTY-THIRD SESSION.

First Ordinary Meeting, 7th December 1846.

SIR THOMAS MAKDOUGALL BRISBANE, Bart., President, in the Chair.

The following Communications were read:—

1. On the Mean Height of the Barometer in different Latitudes. By Professor Hansteen of Christiania. Communicated in a letter to the Secretary.

Professor Hansteen first shews, that the remarkable difference of 1·62 French lines, by which the barometer reduced to the level of the sea, is higher at Paris than at Christiania, cannot be ascribed solely to the effect of the difference of gravity of the mercury in the barometer at the two places. The author then gives an empirical formula to represent the mean height of the barometer in any latitude which he compares with observations. This formula is the following—

$$\psi = 336{\cdot}810 + 1{\cdot}304 \cos. 2\varphi - {\cdot}748 \cos. 4\varphi - 0{\cdot}914 \cos. 6\varphi + 0{\cdot}543 \cos. 8\varphi.$$

Where ψ is the oscillation in French lines, and φ the latitude.

It gives a minimum for $\varphi = 0$, and $\varphi = 68° 24'$.
And maximum for $\varphi = 36° 13'$, and $\varphi = 90$.

The following table gives φ for every fifth degree of latitude :—

φ	ψ
0	336·995
5	7·012
10	7·096
15	7·291
20	7·623
25	8·057
30	8·478
35	8·714
40	8·612
45	8·101
50	337·246
55	6·240
60	5·345
65	4·801
70	4·715
75	5·037
80	5·561
85	6·034
90	6·216

2. On the Extent to which Fluoride of Calcium is Soluble in Water at 60° F. By Dr George Wilson.

Dr Wilson stated, that the object of his communication was to supplement a paper read to the Royal Society, April 6, 1846, on the solubility of fluoride of calcium in water. He was not then able to state the extent of its solubility in that liquid, but he has since ascertained the weight of the salt in question, which water at 60° can dissolve. The solutions referred to in the following statements were prepared from native well-crystallized fluor-spar. This was first digested in warm dilute aqua regia, to remove any trace of metallic oxides, soluble lime-salts, or other foreign matters, and afterwards carefully washed till it exhibited no acid reaction. Distilled water was then boiled on the purified fluor till it became saturated; the solution filtered whilst warm, and left at rest for some days in stoppered bottles, at a temperature of about 60°, till it deposited the excess of salt soluble above that temperature. It was then filtered a second time. A certain volume of this solution, measured at 60°, was evaporated to dryness on the vapour bath, in a counterpoised platina basin.

Twenty-four pints of the solution were thus made use of. In six experiments, 1 imperial pint of the solution (16 fluid ounces, or 7000 grs.) was taken at each trial. In four trials, 3 pints were evaporated at each experiment. In one, 6 pints were employed.

The following are the results :—

			Per Pint.
Exp. 1.	Evaporated 1 pint of solution.	Residue,	0·27 grs.
Exp. 2.	,, ,, ,,	,,	0·28 ,,
Exp. 3.	,, ,, ,,	,,	0·28 ,,
Exp. 4.	,, ,, ,,	,,	0·24 ,,
Exp. 5.	,, ,, ,,	,,	0·27 ,,
Exp. 6.	,, ,, ,,	,,	0·25 ,,

Average, 0·265 per pint.

			Per Pint.
Exp. 7.	Evaporated 3 pints of solution.	Residue, 0·79	= 0·263 grs.
Exp. 8.	,, ,, ,,	,, 0·78	= 0·260 ,,
Exp. 9.	,, ,, ,,	,, 0·78	= 0·260 ,,
Exp. 10.	,, ,, ,,	,, 0·77	= 0·257 ,,

Average, 0·260 per pint.

			Per Pint.
Exp. 11.	Evaporated 6 pints of solution.	Residue, 1·62	= 0·270 grs.

Average, 0·270 per pint.

Twenty-four pints of distilled water thus dissolved 6·330 grains of fluor-spar, so that the mean amount dissolved by one pint will be 0·2637 grains. One grain, therefore, of fluor will require 26·545 grains of water at 60° to dissolve it, or water, at that temperature, will take up $\frac{1}{26545}$th of its weight of that salt.

The solubility here indicated must be considered great for a salt hitherto reputed quite insoluble. It is still more soluble in water at a high temperature, as the deposit left by warm solutions on cooling shews.

These facts will now be connected with the appearance of fluoride of calcium in plants and minerals, as well as in mineral veins and elsewhere; and may, perhaps, prove sufficient to explain these hitherto somewhat perplexing phenomena.

3. New Observations on the Glaciers of Savoy. Part I. By Professor J. D. Forbes.

This paper describes the remarkable changes which the glacier of La Brenva, on the south side of Mont Blanc, has undergone between the years 1842 and 1846.

It has increased to such an extent, that it has risen against the opposing wall of rock on the side of the valley nearly 200 feet vertically; it has covered a large additional surface of ground, and appears to be approaching the moraines of 1818. The author describes the measures which he took for comparing its size at any future period, and he cites some observations made by the Vicar of Courmayeur (M. Guicharda), which plainly establish its continued motion during winter.

Professor Forbes then describes the remarkable development of the *veined structure* which has occurred since his last observations opposite to the promontory of rock on which the chapel is built, which was formerly partially ruined by the glacier. He is of opinion, that the position in which the veined structure has been developed is conclusive as to its cause, being the *forced separation* of the central parts of the glacial mass from the lateral portion, which has become checked by the rocky promontory alluded to, in such a way as to assist the motion of the sides of the glacier, in a way which was not the case in 1842. He confirms this view by actual observations of the velocity of different parts of the glacier, which shew that the lateral ice is completely embayed, and must undergo such a wrench from the central part as had been supposed, to which the veined structure is ascribed.

The following Gentleman was duly elected an Ordinary Fellow:—

C. P. Smyth, Esq., Professor of Practical Astronomy in the University of Edinburgh.

The following Donations of Books to the Library were announced:

The Electrical Magazine, conducted by Mr Charles V. Walker, for April, July, and October 1846.—*By the Editor.*

Annuaire de l'Observatoire Royal de Bruxelles, par le Directeur A. Quetelet, pour l'Année 1846.

Lettres au Duc Regnant de Saxe-Cobourg et Gotha, sur la Theorie des Probabilités, appliquée aux Sciences Morales et Politiques, par A. Quetelet.—*By the Author.*

Annuaire de l'Academie Royale des Sciences des Lettres et des Beaux Arts de Belgique pour 1846.

Bulletins de l'Academie Royale des Sciences et Belle Lettres de Bruxelles. Tome XII. $P^{tie.}$ 2.—*By the Academy.*

Proceedings of the Royal Society. Nos. 62, 63, 64, and 65.

Philosophical Transactions of the Royal Society of London for the year 1846. Parts 1, 2, 3.—*By the Royal Society.*

The Thirteenth Annual Report of the Royal Polytechnic Society.—*By the Society.*

Structure and Classification of Zoophytes. By James D. Dana, A.M.—*By the Author.*

Nachrichten von der Georg-Augusts Universitäts und der Konigl. Gesellschaft der Wissenschaften zu Göttingen. Von Juli bis December 1845.—*By the Royal Society of Sciences of Göttingen.*

Handbuch der Mineralogie von J. F. L. Hausmann, Zweiter Theil. Dritte Abtheilung.—*By the Author.*

United States Exploring Expedition—Zoophytes. By James D. Dana.—*By the Author.*

Flora Batava. Nos. 141, 142, and 143.—*By the King of the Netherlands.*

Report of the Fifteenth Meeting of the British Association for the Advancement of Science, held at Cambridge in 1845.—*By the British Association.*

Journal of the Asiatic Society of Bengal. Nos. 164, 167.—*By the Society.*

Journal of the Statistical Society of London. Vol. IX., Parts 2, 3. —*By the Society.*

Journal of the Royal Asiatic Society. Vol. X., Part 1.—*By the Society.*

Bulletin de la Société de Geographie. (3$^{me.}$ Serie), Tomes IV. et V. —*By the Society.*

Archæologia; or, Miscellaneous Tracts relating to Antiquity; published by the Society of Antiquaries of London. Vol. XXXI. —*By the Society.*

Memoirs of the American Academy of Arts and Science. (New Series), Vol. II.—*By the Academy.*

Bulletin des Séances de la Societe Vaudoise des Sciences Naturelles. Tome I.—*By the Society.*

Monthly Prize Essays. Vol. I., No. 1.—*By the Director.*

The Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland, for July and October.—*By the Society.*

Proceedings of the Zoological Society of London, Jan. 14 to Dec. 9, 1845.—*By the Society.*

Memoirs of the Geological Survey of Great Britain, and of the Museum of Economic Geology in London. Vol. I.—*By the Lords Commissioners of Her Majesty's Treasury.*

Memoires de la Société Royale des Antiquaires du Nord, 1844.

Bulletin de la Société Royale des Antiquaires du Nord, 1843.—*By the Society.*

Abhandlungen Herausgegeben von der Fürstlich Jablonowskischen Gesellschaft.

The American Journal of Science and Arts, conducted by Professors B. Silliman and B. Silliman Jun., and James D. Dana, for July and Sept.—*By the Editors.*

Memoires de la Société Physique et d'Histoire Naturelle de Genève. Tome XI., $P^{tie.}$ 1.—*By the Society.*

The Journal of the Royal Geographical Society of London. Vol. XVI., Part 1.—*By the Society.*

The Quarterly Journal of the Geological Society. Nos. 7 and 8. Edited by the Vice Secretary.—*By the Society.*

Astronomische Nachrichten. Nos. 539 to 559.—*By Professor Schumacher.*

Report to the Principal Secretary of State for the Home Department on the Royal Observatory of Edinburgh.—*By Professor Smyth.*

Scheikundige Onderzoekingen gedaan in het Laboratorium der Utrechtsche Hoogeschool. Deel III., Stuk. 5.—*By the Editors.*

Memoirs and Proceedings of the Chemical Society. Part. 19.—*By the Society.*

Annuaire Magnétique et Météorologique du Corps des Ingenieurs des Mines de Russie. Par A. F. Kupffer, 1843. Nos. 1 and 2.—*By the Author.*

Report of the Astronomer-Royal, Greenwich, to the Board of Visitors, 1846.—*By the Author.*

Biographical Sketch of the late Robert Graham, M.D., Professor of Botany in the University of Edinburgh. By Charles Ransford, M.D.—*By the Author.*

Correspondence of the late James Watt on his Discovery of the Theory of the Composition of Water. Edited by J. P. Muirhead, Esq.—*By the Editor.*

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1844, under the direction of George Biddell Airy, Esq. M.A., Astronomer-Royal.—*By the Royal Society.*

Bericht uber die zur Bekanntmachung geeigneten Verhandlungen der Königl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1845 bis Juni 1846.

Abhandlungen der Koniglichen Akademie der Wissenschaften zu Berlin, 1844.—*By the Academy.*

On the superficial Detritus of Sweden, and on the probable causes which have affected the surface of the Rocks in the Central and Southern portions of that Kingdom. By Sir Roderick Impey Murchison.—*By the Author.*

Address to the British Association for the Advancement of Science, September 10, 1846. By Sir Roderick Impey Murchison, President.—*By the Author.*

Det Kongelige Danske Videnskabernes Selskabs Naturvidenskabalige og Mathematiske Afhandlinger. Deel XI.

Do. Do. Do.

Historiske og Philosophiske Afhandlinger. Deel VII.—*By the Royal Society of Sciences of Copenhagen.*

Mnemonic Dictionary of Languages, arranged in Mnemonic Tables. By A. Jazwinski, Doctor in Philosophy.—*By the Author.*

Monday, 21*st December* 1846.

SIR GEORGE S. MACKENZIE, Bart., V.P., in the Chair.

The following Communications were read:—

1. New Observations on the Glaciers of Savoy, (concluded). By Professor Forbes.

The Second Part of this paper contained an account of the determination of the motions of several glaciers which had not been before observed, such as the glacier of Talefre, Nant Blanc, Miage, and Brenva, and the results of a comparison of the measures made in 1846 with those of former years, at different points of the Mer de Glace; shewing the unusual speed of motion during last summer. There is detailed also the history of the loss of a knapsack in the ice of the glacier of Talefre in 1836, and the recovery of its fragments in 1846, shewing a motion of 4300 feet in ten years, on a declivity of about 15° at a mean. Some remarks were then made on the process of the conversion of the *névé* into glacier, which the author ascribes entirely to intense pressure and friction, aided by the molecular influences which time develops. The first stage of *glacification* is the formation of the *blue bands*, nearly vertical, which are due to the friction arising from the differential motion of the particles. The paper concludes by some remarks on the apparent ejection of stones and other foreign bodies from glaciers.

2. On General Differentiation. Part III. By the Rev. Professor Kelland.

The object of this memoir is to effect the solution of differential equations, and equations of differences, in which the index of differentiation is a simple fraction. The process employed is the calculus of operations in which symbols of operation are treated in the same way as symbols of quantity, provided the former are subject to the same laws as the latter.

3. Dr T. Anderson communicated the following Extracts from a Letter of Baron Berzelius:—

"In the investigation of the vegetable alkalies which I have made for the new edition of my Hand-Book, I consider myself to have established, in a satisfactory manner, that the alkaline constituent of these substances is ammonia, coupled with a variety of different compounds, such as carbo-hydrogens, organic oxides, chlorides, oxychlorides, sulphurets, amides, and even saline compounds. The ammonia in these substances can be converted into amide, ammonium, or oxide of ammonium, under different circumstances. Although, however, I conceive we are now on the right road with the basic constituent of the alkaloïds, we are still very much in the dark with regard to the substances which are coupled with the ammonia. The investigation of these will be a much more difficult problem, if, indeed, we ever succeed in solving it.

"I had, during the month of October, a visit of Fritsche of St Petersburg, accompanied by young Struve, the son of the astronomer, in companionship with whom, Fritsche has discovered and examined a new acid compound of osmium, part of the investigations of which were performed in my laboratory. This acid is of great theoretical interest; it is a fulminating acid, whose silver salt explodes at 66° Cent. as violently as the fulminate of silver. As far as the difficult analyses have gone, its constitution is—

$$Os\,O_4 + Os\,N.$$

It is therefore osmic acid, coupled with the niturет of osmium, and constitutes, as nearly as may well be, a proof of the view which I some time since suggested, with regard to the constitution of the common fulminic acid, viz., that it might consist of a non-explosive acid, coupled with a metallic niturет.

"Schonbein's gun-cotton is now interesting all our chemists. I have found that lignin is the substance which produces this compound, and that it may be obtained from the lignin of any vegetable. It is not xyloidine, which is a compound peculiar to starch alone. I have prepared it, for example, from the *sphagnum palustre*, which had been previously treated with potash; and, best of all, from decayed wood (also after treatment with potash), which will probably form the cheapest raw material for its preparation, especially in a country so rich in forests and half-rotten saw-dust as ours is. Reindeer moss and Iceland moss afford only xyloidine when treated with nitric acid.

"I consider the gun-cotton to be a sort of nitrate of lignin, and the products of its explosion contain much cyanogen; so that its constitution must be such, that the nitric acid may exactly suffice to form carbonic acid and cyanogen, with the carbon $= 2\ NO_5 + C_9$, together with HO, in a hitherto undetermined quantity."

The following Donations to the Library were announced:—

Journal of the Statistical Society of London. Vol. IX., Part 4.—*By the Society.*

Elements of Chemistry. By the late Edward Turner, M.D. Edited by Baron Liebig and William Gregory, M.D. Part 1.—*By Messrs Taylor and Walton.*

Magnetical and Meterological Observations made at Washington, under orders of the Hon. Secretary of the Navy, dated Aug. 13, 1838.

Astronomical Observations made at the Naval Observatory, Washington, under orders of the Hon. Secretary of the Navy, dated Aug. 13, 1838.—*By Lieutenant Gillis.*

Irish Ordnance Survey Maps—County Kerry.—*By the Lord Lieutenant of Ireland.*

Memoires de l'Academie Imperiale des Sciences de St Petersbourg. (Sciences Mathematiques, &c.) Tome IV., Liv^{re} 2.

Memoires de l'Academie Imperiale des Sciences de St Petersbourg. (Sciences Naturelles.) Tome V., Liv^{res} 3, 4.

Memoires de l'Academie Imperiale des Sciences de St Petersbourg. (Memoires Presentés par divers Savants.) Tome V. et Tome VI., Liv^{re} 1.—*By the Imperial Academy.*

Monday, 4th January 1847.

SIR THOMAS M. BRISBANE, Bart., President, in the Chair.

The following Communications were read:—

1. On the presumed long-continued Presence of Arsenic in the Human Stomach. By Dr Gregory.
2. Notes on the Superficial Strata of the Neighbourhood of Edinburgh. By Dr Fleming. (Commenced.)

The following Gentlemen were duly elected Ordinary Fellows:—

GEORGE MAKGILL, Esq. of Kembach.
DAVID GRAY, Esq., M.A., Professor of Natural Philosophy, Marischal College, Aberdeen.

The following Donations to the Library were announced:—

Journal of Agriculture and Transactions of the Highland and Agricultural Society, for January.—*By the Society.*

Inquiry into some points of the Sanatory State of Edinburgh. By James Stark, M.D.

Report of the Mortality of Edinburgh and Leith for the Six Months, June to November 1846. By James Stark, M.D.—*By the Author.*

Proceedings of the Linnean Society of London. Nos. 27, 28, and 29.

Transactions of the Linnean Society of London. Vol. XX., Part 1.—*By the Society.*

Twenty-sixth Report of the Council of the Leeds Philosophical and Literary Society at the Close of the Session 1845-46.—*By the Society.*

Report of the Proceedings in the Cambridge Observatory Relative to the New Planet. By Professor J. Challis.—*By the Vice-Chancellor of the University.*

Observations on the General and Medical Management of Indian Jails; and on the Treatment of some of the Principal Diseases which Infest them. By James Hutchinson, Esq., Surgeon on the Bengal Establishment, &c.—*By the Author.*

Monday, 18*th January* 1847.

SIR GEORGE S. MACKENZIE, Bart., V.P., in the Chair.

The following Communications were read:—

1. An Attempt to Elucidate and Apply Mr Warren's Doctrine respecting the Square Root of Negative Quantities. By the Right Rev. Bishop Terrot.

The author shewed, in the first place, that the successive radii of a circle forming equal angles with one another, are properly symbolized by the successive expressions, a, $a \cdot 1^{\frac{\vartheta}{2\pi}}$, $a \cdot 1^{\frac{2\vartheta}{2\pi}}$ &c., where a is the arithmetical length of the radius, and ϑ the angle which the several radii make with one another. He proceeded to shew how this theory of symbols, first advanced by Mr Warren, is applicable to the problems of plane trigonometry. This was shewn in several elementary propositions, in a new demonstration of Cotes' properties of the circle, and in the demonstration of a property closely connected with these, namely, that if A be the extremity of a diameter, and P, P_1, P_2, P_3, &c., be the extremities of a series of equal arcs measured in the same direction from it, then $A P_1 \times A P_2 \ldots \times A P_{n-1} = n R^{n-1}$. The author finally shewed that though this symbolism is applicable to the most elementary propositions of geometry, it is applicable under forms which are unsuitable to the purposes of elementary instruction.

2. Notes on the Superficial Strata of the Neighbourhood of Edinburgh, concluded. By Dr Fleming.

The author began by adverting to the position of Edinburgh as favourable to the study of geology, from the proximity of the transition rocks, the old red sandstone, and the coal measures; and then stated, that the deposits belonging to the modern epoch were equally accessible and interesting.

In order to illustrate the character of the superficial strata, the author considered, in the first instance, the condition of the *surfaces of the rocks*, on which these loose deposits rest. He had found many examples, as at Craigleith, Granton, and Sampson's Ribs, where, on the removal of the boulder-clay, the surfaces of the rocks were *dressed* and scratched in a direction nearly from W. to E.; while in other cases, as on Arthur's Seat, the Calton Hill, and Torduff to the westward of Bonally, near Colinton, the surfaces were equally dressed and scratched although the superficial strata were absent.

In the neighbourhood of Edinburgh, the oldest member of the superficial strata is the BOULDER-CLAY, which rests on the dressed surfaces. The *boulders* are chiefly of trap, rounded, and, in many instances, scratched, and the accompanying *fragments* are portions of the strata in the immediate neighbourhood. The author was inclined to the belief, that the boulders had acquired their form previous to their enclosure in the clay, through which they are irregularly distributed, scarcely ever in *contact*; and in which, even supposing the mass in motion, they must, in a great measure, be in relative rest.

The author considered it probable, that the *dressing* had taken place previous to the formation of the boulder-clay, and at the period when the boulders themselves acquired their form; and that it was produced, when the rocks were under water, by the attrition of stones or ice. He here adverted to the action of icebergs, and considered their influence as having been exerted in *fresh water*, according to a notion which he had long entertained, that, during the formation of the older members of the superficial strata, the land under consideration was covered by a lake of fresh water. He then adverted to the glacial theory of Agassiz, as well fitted, if otherwise probable, to account for the dressings; because, if a sheet of ice covered the country for a series of years, it must have experienced innumerable shiftings, and produced corresponding abrasion of the rocks, *by its expansions and contractions as a solid*, with every change of temperature, independent of any dilatation by freezing.

The author here took notice of the structural character of the trap rocks of the district, as exhibiting, in the *crumpled surfaces* of their strata, and the *slickensides* with which they abound, appearances which may readily be confounded with *dressings*.

The difficulties attending any explanation, yet proposed, of the mode of formation of the boulder-clay, the author considered as very great, and frankly stated that hitherto he had not been able to arrive at any satisfactory conclusion.

The boulder-clay becomes more sandy towards the upper portion of the mass, and passes, by means of alternating beds, into the next newest formation, the boulder gravel and sand. The gravel forms the lowest portion of this mass, and frequently contains numerous boulders of trap towards its lowest portion. The sand towards the upper portion is horizontally stratified with numerous examples of disturbance, while, towards the boulder-clay, it is very imperfectly assorted by water. Throughout the upper portion of the mass there are beds of silt or brick-clay.

The author then proceeded to the consideration of the great deposits of brick-clay and stratified sand at Portobello and Granton. At the former place the clay is finely stratified, graduating by alternations with fine sand, into the incumbent sand. At Granton the brick-clay is very imperfectly stratified, and is abruptly covered with a mass of gravel distinctly assorted by water.

On comparing the relative position of the boulder-clay, gravel, sands, and silt, and their transitions, the author considers them as the production of a single series of changes, and in the later stages as having a soil with plants and animals at no great distance.

The subject of *Erratics* was next brought under the notice of the Society; and the author remarked that those which occur on the surface, at the north end of Salisbury Crags, had probably been exposed by the washing away of the boulder-clay. There were no angular blocks resting on the surface to be seen in the immediate neighbourhood, such as abound in the district around Aberdeen, and which are different from the contents of the inferior clay.

The Marine Diluvium next occupied the attention of the author. He stated that this deposit occurred on the sea-shore from Portobello to Granton, and had been regarded as an ancient sea-beach, now exposed in a raised position by an elevation of the land. The author, after illustrating the character of a modern sea-beach, stated that this bank of shells did not exhibit any of the characters of a beach, but gave unequivocal proofs of its being *storm-raised*, in the mixture of littoral and deep water shells, in overturned boulders with limpets, barnacles, &c., in their original position, in the direction of flat stones in the bed, and in the appearances of stratification. This view the author stated had been forced upon him by an examination of the prolongation of the same bed at Borrowstonness, and which he had published in Dr Thomson's Annals of Philosophy, for August 1814.

The author concluded his remarks by stating, that the sea-shells found a few feet below the surface of the *carse clay* at Clackmannan, Stirling, &c., were in like manner derived from a violent inundation of the sea, and could not be considered as an old sea-beach—an opinion which had been adopted by several of the authors of illustrations of the geology of the district, on very insufficient grounds.

Monday, 1st February 1847.

SIR THOMAS M. BRISBANE, Bart., President in the Chair.

The following Communications were read:—

1. Speculation respecting the origin of Trap-Tuff, the Cause of Earthquakes, and of Partial Changes of the Bed of the Ocean. Part I. By Sir G. S. Mackenzie, Bart.
2. On the Principle of Vital Affinity. Part II. By Dr Alison.

The following Gentlemen were duly elected Ordinary Fellows:—

W. THOMSON, Esq., Professor of Natural Philosophy in the University of Glasgow.
J. H. BURTON, Esq., Advocate.

The following Donations to the Library were announced:—

On the Volcanoes of the Moon. By James D. Dana.—*By the Author.*

Eleventh, Twelfth, and Thirteenth Letters on Glaciers. By Professor J. D. Forbes.—*By the Author.*

Illustrations of the Viscous Theory of Glacier Motion. From the London Philosophical Transactions. By James D. Forbes, F.R.S.S.L. and E.—*By the Author.*

Zur Vergleichenden Physiologie der Wirbellosen Thiere. Von Dr Carl Schmidt.—*By the Author.*

Entwurf einer Allgemeinen Untersuchungs Methode der Säfte und Excrete des Thiereschen Organismus. Von Carl Schmidt.—*By the Author.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By the late Thomas Henderson, F.R.S.S.L. and E. Reduced and Edited by his Successor, Charles Piazzi Smyth. Vol. VI., for the year 1840.—*By the Astronomical Observatory.*

On the Laws of the Tides on the Coasts of Ireland. By G. B. Airy, F.R.S.—*By the Author.*

An Explanation of the Observed Irregularities in the Motion of

Uranus on the Hypothesis of Disturbances caused by a more Distant Planet. By J. C. Adams, Esq. M.A. *By the Author.*

Scheikundige Onderzoekingen gedaan in het Laboratorium der Utrechtsche Hoogeschool. Deel 4de., Stuk 1ste.—*By the Editors.*

Guide to the Geology of Scotland. By James Nicol, Esq.—*By the Author.*

Account of Iceland, Greenland, and the Faroe Islands. By the same.—*By the Author.*

Specimen of Metamorphic Limestone, dislocated by the vicinity of Trap-Rocks, near North Berwick.—*By Sir G. S. Mackenzie, Bart.*

Monday, 15*th February* 1847.

Dr CHRISTISON, Vice-President, in the Chair.

The following Communications were read:—

1. A Speculation, connecting the origin of Trap-Tuff, the cause of Earthquakes, and of Partial Changes of the Bed of the Ocean. Part II. By Sir G. S. Mackenzie, Bart.

The author, having observed in Iceland some remarkable intermixtures of lava with volcanic tuff; and, more recently, on the coast of East Lothian, a somewhat similar intermixture of masses of greenstone in trap-tuff, conceived the idea that cavities existed underneath the crust of the earth, or deeply seated within it, containing water exposed to heat, and the agitation of which, occasioned by the production of steam, had reduced the materials of trap-tuff to the state in which we find them, which had been afterwards erupted at the bottom of the sea, or forced between the beds of superincumbent rocks. Some time afterwards, on reading the researches of Mr Hopkins in Physical Geology, he was gratified to find that profound philosopher advocating the existence of vast cavities containing lava, and connected with volcanic vents at a depth such as would admit of steam-power throwing the lava to the surface. It did not now appear difficult to imagine similar cavities containing heated water, and the materials of trap-tuff; and he therefore extended the hypothesis of Mr Hopkins so as to account for its origin, and for masses of trap occurring in it, the form of which seemed to indicate that they had been forced into the tuff at the time of its eruption, from some neighbouring cavity containing melted matter.

The author next adverted to the phenomena of earthquakes; and referring to the Great Geyser, the eruptions of which, at the time when he saw it, were preceded by sounds resembling the discharges of artillery, and trembling of the ground, he inferred that the noises and shaking of the ground during earthquakes, were caused in the same manner in great cavities, such, most probably, as those which contained the materials for trap or volcanic tuff. The cause of the noises the author conceived to be the occasional production of masses of steam, reaching the upper and colder portions of the cavity, or coming in contact with water and being suddenly condensed, so as to produce a vacuum with extreme rapidity, the collapse, on its being instantly filled up, causing sound and concussion. To explain this part of the subject, he referred to a paper on sound, which he had read to the Society some years before, and part of which will appear in the number of Jameson's Journal for April 1847.

The author next proceeded to extend the hypothesis of Mr Hopkins farther; and endeavoured to shew, that the operations going on within the cavities would necessarily go on extending their dimensions, and weakening their roofs. This weakening would be greatly increased by the eruption of the contained matter, and the enormous masses of igneous rocks existing in volcanic districts and elsewhere, proves that proportional spaces must have been left empty underneath. Vast tracts of land by being thus undermined may have sunk and disappeared under the ocean. Several geologists have supposed it probable, from various facts, that Europe and America were once united, the Northern Atlantic having been occupied by land. This being admitted, the author referred to the probability of the sinking of the land having been caused (perhaps in large portions at different periods) by the extension of such cavities as those which Mr Hopkins has supposed to exist, and to their roof giving way. The British Islands, the Faroe Island, and Iceland, may be regarded as remnants of the lost continent; and the latter island exhibits the strongest possible indications of preparation for the catastrophe of its disappearance. The precipitous shores of these remnants prove that violent fracture had taken place; and that this island had been more elevated at a former period, is rendered probable by the exceedingly shattered condition of their rocks. Admitting this, and the extension of the land over the Atlantic, the climate of Britain must formerly have been severe enough to produce glaciers, which have left those marks which have been ascribed to them.

The author took occasion to shew, that the effect of the sudden sinking of a great mass of land, and the access of the sea to the emptied space, would be to raise, by vast currents rushing into it, an enormous mass of water to a great height, forming a huge initiatory wave, consisting of greatly agitated water, loaded with the debris of the former land, as well as terrestrial and aquatic animals, many of them dragged from warmer latitudes, by the violent currents rushing from all sides towards the empty space. This huge mass of water, as soon as its weight balanced and overcame the momentum of the current that had lifted it, would produce a wave which, being propagated till it reached our land, would break over it, and form powerful currents guided by the inequalities of the land, and leaving behind them the detritus which at present covers the rock surface.

The author also noticed, in consequence of some discussion that had taken place on the appearances presented by the diluvial masses, a fact he had several times observed, shewing that the appearance of stratification might not, in every case, depend on deposition from water comparatively at rest. On artificial heaps of heterogeneous matter which had been left undisturbed for many years, being cut down, he had noticed, and pointed out to others, that the materials had arranged themselves in lines, in the manner of flint in chalk, and strata of finer materials. Hence he supposed it probable that, in many cases, the diluvial masses had, in like manner, arranged themselves, and assumed a stratified appearance. He was led also to the inference that, instead of having been quietly deposited, many of the great masses of sandstone, now exhibiting distinct layers, had been produced at once by ancient debacles.

2. On Vital Affinity. Parts II. and III. By Dr Alison.

In continuation of his former paper, Dr Alison proceeded to review the chief facts known in regard to the formation of the *oils* and the *albuminous* compounds in organized bodies, with the view of illustrating the modification given by vitality to chemical affinities. The formation of fat or oil in vegetables appears to be effected simply by the separation of oxygen from some of the varieties of starch; but in animals, where no oxygen is evolved, and where, nevertheless, oily compounds may certainly be formed from starch (as shewn by Liebig, Chevreul, and Milne-Edwards), this appears to be effected by an affinity of the greater part of the carbon and hydrogen of the starch, for a small part of the oxygen, to form fat, while a smaller part of the carbon and hydrogen, with the greater part of the oxygen of the starch, aided by additional oxygen absorbed from the air, passes off as carbonic acid and water. In both cases, the essential characters of that affinity, which appears to be peculiar to the state of life, lies apparently in the attraction of carbon for hydrogen, with a much smaller proportion of oxygen than exists in the compounds of these elements existing in the inorganic world; and as no such compound is formed from starch, under the same circumstances in other respects, without the presence of living cells, he regards the formation of oil in living bodies as an effect of vital affinity; although admitting that in the course of the decomposition of animal compounds, by various chemical agents, oily matters may be formed by simple chemical action, as in the well-known example of the formation of adipocere from fibrin.

The fact that the formation of fat in the animal body is so notoriously diminished or restrained by exercise, increasing the supply of oxygen, and promoting, therefore, the excretion of carbonic acid and water, he thinks very important, as indicating, along with other facts, the principle that vital affinities do not supersede the usual chemical relations of the elements that are liable to them, but are merely added to these, and allow of a division of those elements between compounds formed by vital and by simply chemical powers.

He next referred to the important question, now warmly disputed among chemists, whether albumen can be formed in the animal body, or only passes into it, directly or indirectly, from vegetables, where it is believed to be formed, by a vital action, from the elements of starch, and those of ammonia (in whatever way this last may be supplied), the elements of water and a little oxygen passing off at the same time in the usual exhalations of the plant. He pointed out that, by the addition of a full supply of oxygen, it is quite possible that the elements of starch with ammonia in the animal body may divide themselves into two portions—the one containing the greater part of the carbon falling by vital affinity into the proportions of the albumen, while the other, absorbing the oxygen, passes off as carbonic acid and water, the constant excretions of animals; and he conjectured that the elements of ammonia, requisite for this action, may be supplied in animals by the air which is continually taken into the stomach, in the water and in the saliva which are habitually swallowed, and which will there be under conditions very similar to those in which air and water are known to form ammonia. He stated likewise that as it is certain that fat is formed in the animal body from starch, and that gelatin is formed in it, probably from albumen, it is certain that the term assimilation, in the physiology of animals, cannot be restricted to the mere selection and appropriation of compounds already formed in vegetables (as Dumas supposes), but must include, also, certain processes of transformation (as maintained by Dr Prout). And admitting that the question, as to the actual formation of albumen in animals, can only be finally decided by ascertaining whether the whole quantity of azote thrown off from an animal in a given time is greater than is introduced into it in the form of albuminous ingesta, he urged various reasons for inclining to the opinion, that a certain quantity of albumen is formed, chiefly from the anylaceous ingesta, in the animal body.

He admitted, however, that a comparison of the proportion of the elements in the azotised aliments, and in the excretions, shews that the formation of albumen in the animal frame must be to a very small extent only; and stated that the general distinction of the azotised, or the chief nutritious portion of the aliments, and the non-azotised or chiefly calorific portion of them, and the doctrine of these last protecting the albuminous part of the blood, and the textures from the agency of the oxygen taken into the blood, and that of the wasting of the textures, and death by anœmia in weakening diseases, being due to the action of the oxygen, appear to him to be quite consonant with clinical observations in various diseases, and to be an important addition to pathology; besides giving us more precise ideas as to the nature of the function of digestion, and the law of Prout, of the necessity of mixture of aliments for the support of animal life. This doctrine is the strongest illustration of what was formerly stated as to the use of the oxygen taken into the animal body, viz.,—not to take any direct part in the formation of compounds by strictly vital affinities, but to exert a simply chemical action on all organic compounds capable of yielding to simply chemical affinities, and so to support the excretions.

The formation of gelatin in the living animal body, he considered as certainly owing to the separation of carbon and hydrogen, by help of the oxygen of the air; but pointed out the possibility of this taking place, not merely, as Liebig states, from the action of the oxygen on the elements of albumen, but likewise from its action on the elements of starch with ammonia, provided that a certain quantity of oil or fat is formed at the same time.

He then proceeded to consider the general theory of excretion in the animal body, beginning this subject with the striking fact, noticed by both Prout and Liebig, that although oxygen from the air must be a main agent in forming all the excretions (because oxygen exists in them all in a larger proportion than in those aliments and those textures of the body from which they must be respectively derived), yet the oxygen taken in at the lungs does not appear to enter into the combinations by which the excretions are formed (particularly, does not form carbonic acid), as long as it is passing along the arteries, but "changes its mode of action" when it reaches the capillaries, where it must meet with the matter absorbed from the textures. He stated it as the general, and apparently first, opinion of physiologists, that the excretions are furnished partly by redundant ingesta, and partly by "effete" matter in the system itself; but the important agency of oxygen in maintaining them had not been so generally recognised, and the term "effete" has in general no very definite idea attached to it. But, combining together all that is known as to the continued interstitial absorption in animal bodies, the continual introduction of oxygen into them, and as to the nature and quantity of the excretions, as compared with the ingesta, he stated it as the most general expression of these facts, that throughout all the parts of any living animal where nutrition and absorption are going on, *i. e.*, at the extremities of the capillary vessels, in the more perfect animals, carbon, nitrogen, hydrogen, and oxygen, are continually forming two sets of compounds,—certain portions of these elements, recently introduced in the form of aliments, either separating, in the form of the organic compounds, from the other constituents of the blood, or uniting to form those compounds,—and in either case attaching to themselves particles of earthy and saline and inflammable bodies, taking the form of cells or fibres, and building up the organised frame; while other portions of the same, which have been for some time in the body, rejecting these adventitious matters, and uniting with oxygen from the air, are continually falling into the proportions by which the compounds destined to excretion are formed, which are poisonous to the system if retained, which tend always to the crystalline form, and, in fact, are steps in the process of the gradual restoration of these elements to the inorganic compounds, carbonic acid, water, and ammonia, out of which the agency of vegetable life had originally formed them.

This general fact he considered as the clearest proof of that principle of the modification of chemical affinities by the contact of living structures, to which the term Vital Affinity is applied; and, at the same time, as an indication of this distinctive peculiarity of the vital affinities, that, like all other actions strictly called vital, they are of *transient duration only;* and that the life of every individual animal is maintained only by the successive life and death of all the atoms of organised matter of which it is composed; every portion, as it dies, being removed from its place by interstitial absorption, becoming liable to the influence of the oxygen (as it would be, if separated from the body, and undergoing decomposition), and serving for the maintenance of the different excretions.

This opinion he stated as having been adopted by several physiologists of late years, in regard to those portions of animal textures which are engaged in active vital operations, particularly muscular and nervous parts; but its importance as a general physiological principle, connecting together the necessity of continued nutrition for the maintenance of animal life (even during the decline of the body), the intention of interstitial absorption, the use of respiration, and the necessity and nature of the excretions, had not, as he thought, been pointed out in any physiological work. He acquiesced, however, in the statement of some recent authors, that this partial death of portions of the animal frame appears to be greatly accelerated by local increase of any of the strictly vital actions; and under this law, he thought we may include not only the fact of the loss of power in a muscular or nervous part from over-exertion (leading to increased interstitial absorption, and thereby, in a healthy constitution, and where the exertion is not excessive, to subsequent deposition and hypertrophy), but likewise, the increased interstitial absorption, the ulcerative absorption, the partial sloughing, or general gangrene of a part that has been inflamed,—all these being results of the death of certain particles of matter concerned in the inflammation, and varying in degree as this death is more partial and gradual, or more general and sudden.

On the whole, therefore, he maintained, that not only the general principle may be held to be ascertained of peculiar vital affinities actuating the portions of matter by which the organic principles are formed, and organised structures developed, but that the facts already known on the subject, justify several important inferences in regard to the peculiarities of these affinities, both as to their nature and duration; and that we can point out, with at least much probability,